OPERATION MANUAL

RD-301
RADAR TEST SET

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OPERATION MANUAL
RD-301

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WARNING:

HIGH VOLTAGE EQUIPMENT

THIS EQUIPMENT CONTAINS CERTAIN CIRCUITS AND/OR COMPONENTS OF EXTREMELY HIGH VOLTAGE POTENTIALS, CAPABLE OF CAUSING SERIOUS BODILY INJURY OR DEATH. WHEN PERFORMING ANY OF THE PROCEDURES CONTAINED IN THIS MANUAL, HEED ALL APPLICABLE SAFETY PRECAUTIONS.

RESCUE OF SHOCK VICTIMS

1. DO NOT ATTEMPT TO PULL OR GRAB THE VICTIM
2. IF POSSIBLE, TURN OFF THE ELECTRICAL POWER.
3. IF YOU CANNOT TURN OFF ELECTRICAL POWER, PUSH, PULL OR LIFT THE VICTIM TO SAFETY USING A WOODEN POLE, A ROPE OR SOME OTHER DRY INSULATING MATERIAL.

FIRST AID

1. AS SOON AS VICTIM IS FREE OF CONTACT WITH SOURCE OF ELECTRICAL SHOCK, MOVE VICTIM A SHORT DISTANCE AWAY FROM SHOCK HAZARD.
2. SEND FOR DOCTOR AND/OR AMBULANCE.
3. KEEP VICTIM WARM, QUIET AND FLAT ON HIS/HER BACK.
4. IF BREATHING HAS STOPPED , ADMINISTER ARTIFICIAL RESUSCITATION. STOP ALL SERIOUS BLEEDING.

CAUTION

- INTEGRATED CIRCUITS AND SOLID STATE DEVICES SUCH AS MOS FET'S, ESPECIALLY CMOS TYPES, ARE SUSCEPTIBLE TO DAMAGE BY ELECTROSTATIC DISCHARGES RECEIVED FROM IMPROPER HANDLING, THE USE OF UNGROUNDED TOOLS, AND IMPROPER STORAGE AND PACKAGING. ANY MAINTENANCE TO THIS UNIT MUST BE PERFORMED WITH THE FOLLOWING PRECAUTIONS:

  1. BEFORE USING IN A CIRCUIT, KEEP ALL LEADS SHORTED TOGETHER EITHER BY THE USE OF VENDOR-SUPPLIED SHORTING SPRINGS OR BY INSERTING LEADS INTO A CONDUCTIVE MATERIAL.

  2. WHEN REMOVING DEVICES FROM THEIR CONTAINERS, GROUND THE HAND BEING USED WITH A CONDUCTIVE WRISTBAND.

  3. TIPS OF SOLDERING IRONS AND/OR ANY TOOLS USED MUST BE GROUNDED.

  4. DEVICES MUST NEVER BE INSERTED INTO NOR REMOVED FROM CIRCUITS WITH POWER ON.

  5. PC BOARD, WHEN TAKEN OUT OF THE SET, MUST BE LAID ON A GROUNDED CONDUCTIVE MAT OR STORED IN A CONDUCTIVE STORAGE BAG.

NOTE

Remove any built-in power source, such as a battery, before laying PC Boards on conductive mat or storing in conductive bag.

  6. PC BOARDS, IF BEING SHIPPED TO THE FACTORY FOR REPAIR, MUST BE PACKAGED IN A CONDUCTIVE BAG AND PLACED IN A WELL-CUSHIONED SHIPPING BOX.

CAUTION

- THE USE OF SIGNAL GENERATORS FOR MAINTENANCE AND OTHER ACTIVITIES CAN BE A SOURCE OF ELECTROMAGNETIC INTERFERENCE TO AVIATION RECEIVERS, WHICH CAN CAUSE DISRUPTION AND INTERFERENCE TO AERONAUTICAL SERVICE OUT TO A DISTANCE OF SEVERAL MILES.

- USERS OF THIS EQUIPMENT SHOULD SCRUTINIZE ANY OPERATION WHICH RESULTS IN RADIATION OF A SIGNAL (DIRECTLY OR INDIRECTLY) AND ENSURE COMPLIANCE WITH INSTRUCTIONS OUTLINED IN FAA CIRCULAR AC 170-6C, DATED FEBRUARY 19, 1981.

RECORD OF REVISIONS

REV NO.	ISSUE DATE	DATE INSERTED	BY	REV NO.	ISSUE DATE	DATE INSERTED	BY
1	OCT 01/87						
2	JUN 21/90						

INTRODUCTION - RD-301 RADAR TEST SET

This Operation Manual provides the basic information necessary to operate the RD-301 Radar Test Set. This Test Set* is designed for precision simulator testing of aircraft weather radar and narrow pulse marine radar instruments.

The manual is divided into five sections as follows:

Section 1 - DESCRIPTION (physical and mechanical description of the Test Set and a list of features.)

Section 2 - OPERATION (explanation of installation; description of controls, connectors and indicators; operation performance check; and general operating procedures.)

Section 3 - SPECIFICATIONS

Section 4 - SHIPPING

Section 5 - STORAGE (for extended periods)

* "Test Set" always refers to the RD-301 Radar Test Set.

CHAPTER 1

RD-301 RADAR TEST SET

OPERATION MANUAL

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SECTION 1 - DESCRIPTION

1. Physical and Mechanical Description

A. The RD-301 is a single unit test set with all controls on the front panel and connectors on the front and rear panels. A description of the controls, connectors and indicators and their operation is in Section 2, paragraph 2.

B. The composite structure of the Test Set is shown in Figure 1, and consists of the following modules:

(1) Front Panel

(2) Display Counter

(3) Floor Assembly

(a) Main Diode Switch

(b) X-Band Front End

(c) VCO and AGC PC Board

(d) Detector Buffer

(e) 8.25 GHz LO

(4) IF and Marker Oscillators PC Board

(5) IF Generator Power Amplifier PC Board

(6) Prescaler PC Board

(7) Card Frame Assembly

(a) Discriminator PC Board #1

(b) Discriminator PC Board #2

(c) Range PC Board #1

(d) Range PC Board #2

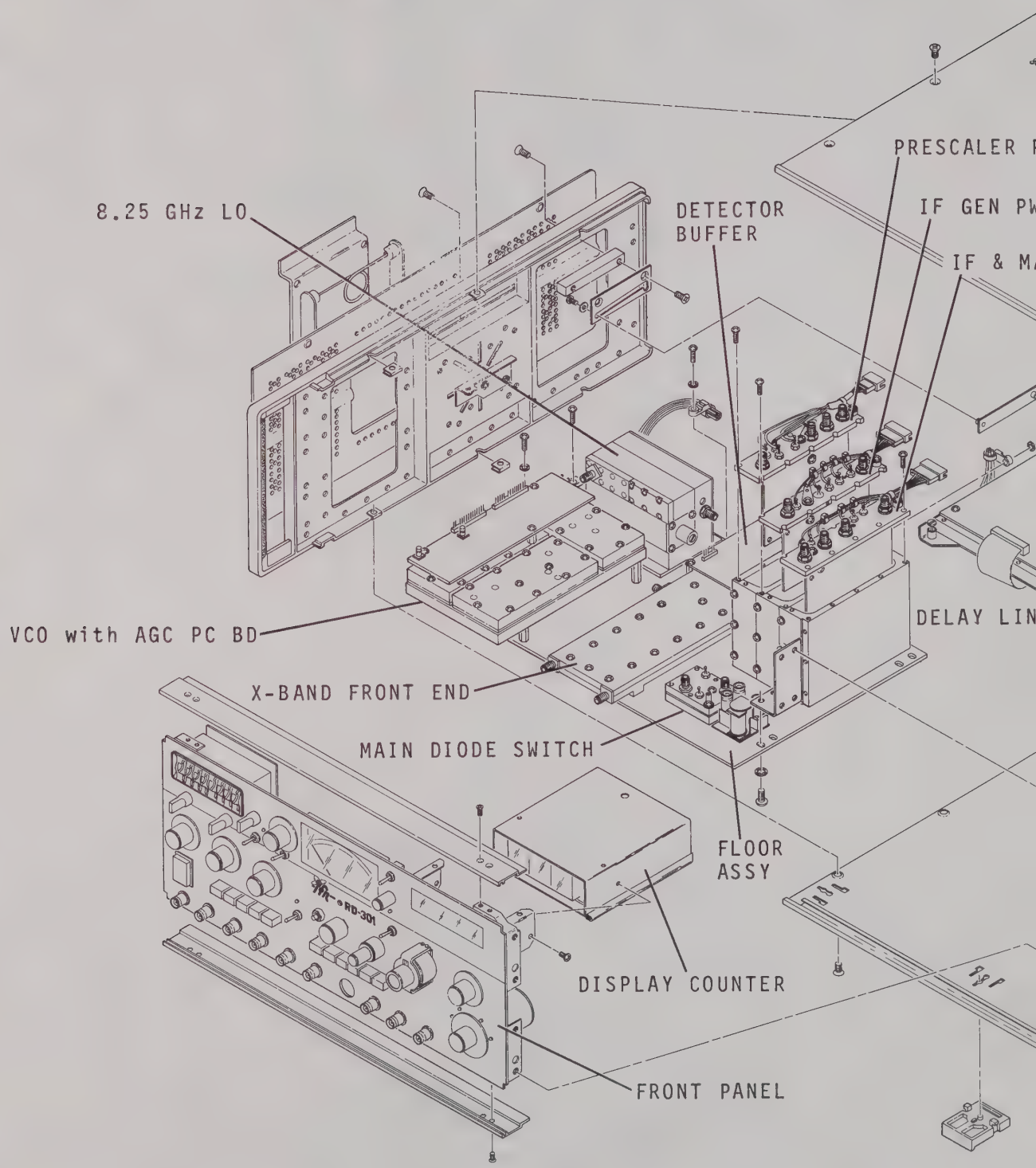
(e) Delay Line

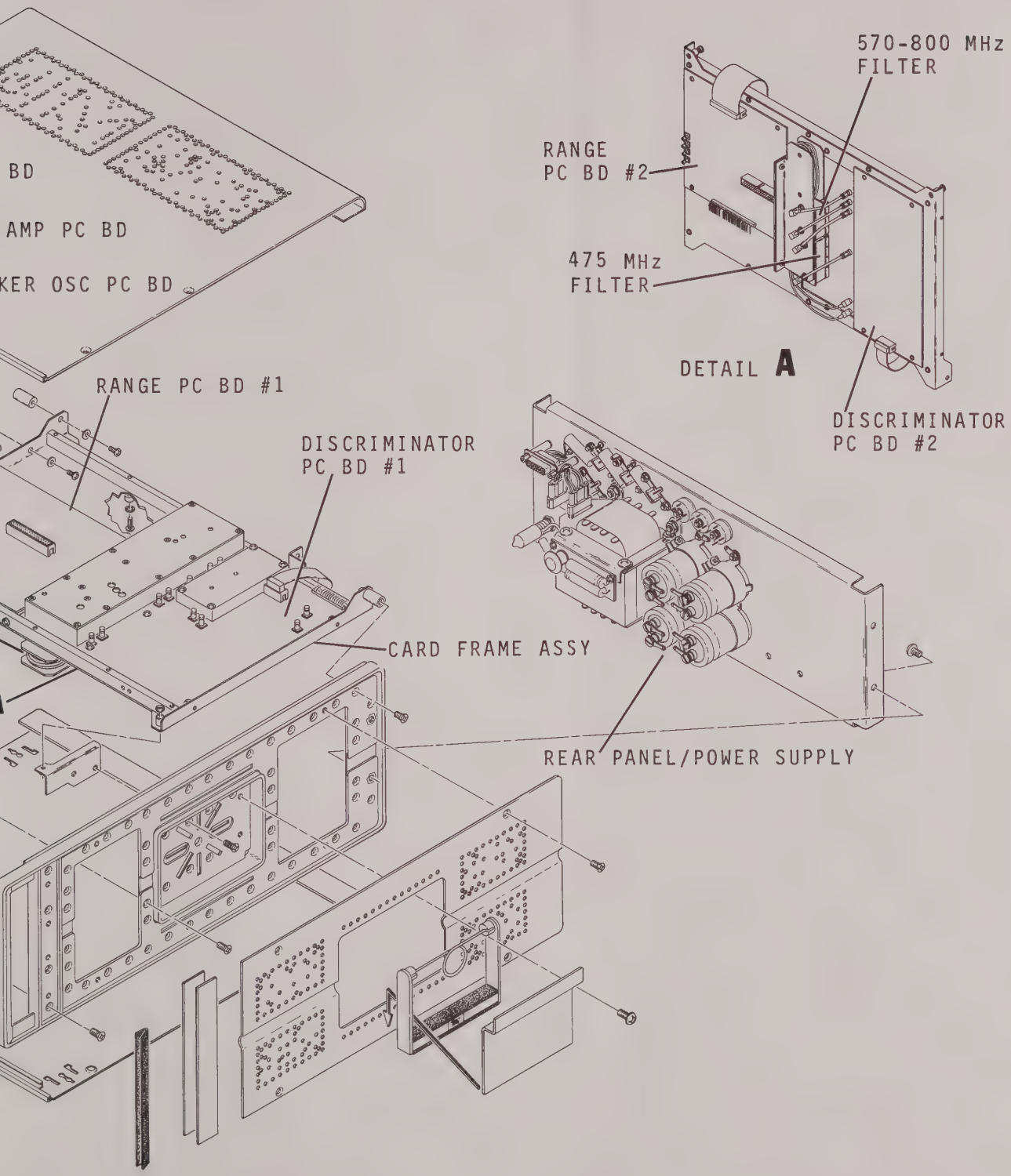
(f) 570-800 MHz Filter

(g) 475 MHz Filter

(8) Rear Panel Assembly/Power Supply

C. Standard accessories for the RD-301 are the serialized coaxial cable, waveguide coupler and dummy load. The RD-301 is calibrated with the serialized coaxial cable and waveguide coupler furnished. Any change in these accessories will require recalibration.


8.25 GHz LO
DETECTOR BUFFER
PRESCALER
IF GEN PW
IF & MA
VCO with AGC PC BD
DELAY LIN
X-BAND FRONT END
MAIN DIODE SWITCH
FLOOR ASSY
DISPLAY COUNTER
FRONT PANEL
RD-301



RD-301 Composite
Figure 1

2. List of Features

A. General

The RD-301 Radar Test Set is designed for precision simulator testing of aircraft weather radar and narrow pulse marine radar instruments. It is a fully integrated unit which permits testing of routine radar functions by the Test Set in conjunction with an external oscilloscope. The RD-301 is connected to the unit-under-test (UUT) by one serialized coaxial cable, waveguide coupler and dummy load. The Test Set can respond to radar interrogation pulse widths of 50 ns to 30 µs in a frequency range of 9295 MHz to 9500 MHz. The capabilities of the RD-301 include testing the following:

Transmitter Frequency
Pulse Repetition Frequency (PRF)
IF System
Sensitivity and Contour
Range Accuracy/Dual Target Resolution
Transmitter Peak Pulse Power

B. Transmitter Frequency and PRF

The RD-301 tracking signal generator system enables the Test Set to automatically acquire and track the transmitter frequency. This basic feature eliminates the need for constant retuning to compensate for transmitter or signal generator drift. Measurement of the transmitter frequency or PRF is shown on the Digital Display. Video Detector and frequency discriminator output connectors allow a check of transmitter pulse shape and spectral characteristics. A ΔF mode allows signal generator frequency offset for AFC centering tests, and receiver IF bandwidth measurements.

C. IF System

Provides a means to align and test radar IF systems through hookup to IF OUT Connector (9). The IF signal generator covers a frequency range of 20 to 70 MHz and is capable of being swept over a 4 MHz span. The high level IF output (2 volts rms max.) can be used for high level IF or AFC testing. Bandwidths and center frequencies are measured by the Marker frequency generator during swept frequency tests.

D. Sensitivity and Contour

Sensitivity of radar UUT can be determined. Also receiver color and intensity responses can be checked. Utilizing contour mode of Test Set to check contour is done by means of an additional 0 to 20 dB amplitude boost over selected output level. This provides for rapid calibration and checking of contour threshold circuits.

E. Range Accuracy/Range Reply Delay/Dual Target Resolution

The RD-301 Test Set is capable of providing two totally separate simulated replies in dynamic amplitudes. Range 1 reply delay can be set from 0.1 to 999.9 in either microseconds (µs) or Nautical Miles (NM). This permits precision testing of range accuracy and receiver sensitivity. The Test Set has the capability of generating 1 through 5 equidistant range rings. The second range reply (providing the Dual Target Resolution capability) is selectable with a variable amplitude of 0 - 59 dB relative to Range 1 reply. Range 2 reply delay can be set from 0.2 to 999.9. The actual Range 2 reply delay is nominally 0.4 µs greater than the selected value. This second reply can be generated in response to all transmitter pulses or alternate transmitter pulses. In Auto mode, Reply 1 will respond to narrow pulses and Reply 2 will respond to wide pulses.

F. Power Measurement

Peak pulse power measurements are shown on the Panel Meter with a full scale sensitivity of up to 12 kW (or up to 120 kW peak with external 10 dB attenuator). Range of operation is from 1 kW to 12 kW. Test Set will operate down to 100 W.

G. Other Capabilities

The RD-301 can also determine threshold measurements for the different video levels, transmitter pulse width measurements, Sensitivity Time Constant (STC) measurements, magnetron pushing measurements, Automatic Frequency Control (AFC) centering and Minimum Discernible Signal (MDS).

SECTION 2 - OPERATION

1. Installation

A. General

The RD-301 Weather Radar Test Set is shipped in a "ready for operation" status. Standard accessories are the coaxial cable, waveguide coupler, and dummy load (see Figure 3). It can be operated in a bench top or rack-mounted position (the rack-mount is accomplished by attachment of optional brackets). Placing the RD-301 into operation consists of the following steps:

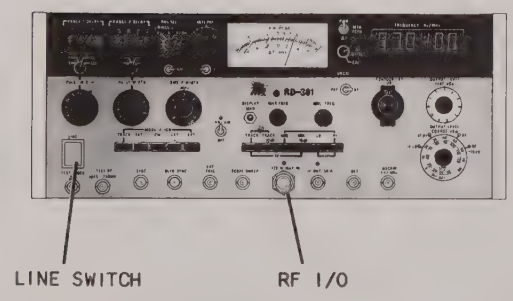
CAUTION: RD-301 TEST SET IS NORMALLY PRE-SET AT THE FACTORY FOR POWER SOURCE AT LOCALITY OF PURCHASER (115/230). THIS SHOULD BE CONFIRMED PRIOR TO USE BY CHECKING RATING INDICATED ON SET (SEE FIGURE 2). FOR ANY REQUIRED RECONFIGURATION, SEE PARAGRAPH B.

(1) Confirm Test Set is properly configured for local power source.

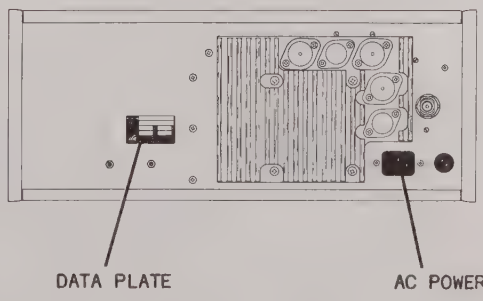
(2) Place Test Set into desired operating position. (Avoid blocking air vent holes.)

(3) Connect furnished AC power cable between appropriate external power source and AC Input Connector on rear panel (see Figure 2).

(4) Depress Line Switch on front panel to apply power (see Figure 1).



RD-301 Front Panel
Figure 1



RD-301 Rear Panel
Figure 2

B. Power Configuration

The RD-301 can be configured to operate at 115 VAC or 230 VAC at a line frequency of 50 to 400 Hz (150 watts line). If a change in power configuration is necessary, the procedure below should be followed:

(1) Disconnect AC power cord from power source.

(2) Remove four (4) screws securing top cover of RD-301.

(3) Slip top cover to rear and remove.

(4) Loosen two captive screws securing Card Frame Assembly located at top level of RD-301. Raise Card Frame Assembly to upright position. Locate transformer at left rear of Test Set (as operator faces front panel).

(5) Mounted at top left of transformer (as seen from front panel) is white female connector with either a marked "110 V" four (4) wire plug or a marked "220 V" two (2) wire male plug inserted. These two plugs (110V/220V) are assembled so as to remain together.

(6) If a change is necessary, remove inappropriate plug and insert appropriate plug. The rectangular plug has a flat end and an arrow-shaped end which should be matched with the similar shaped ends of the female receptacle. The plugs will snap firmly into place.

(7) For "110V" operation, the fuse should be 1 amp. For "220V" operation, the fuse should be ½ amp.

C. Installation and Operation Precautions

To prevent possible damage, the following power input and general operating precautions should be observed:

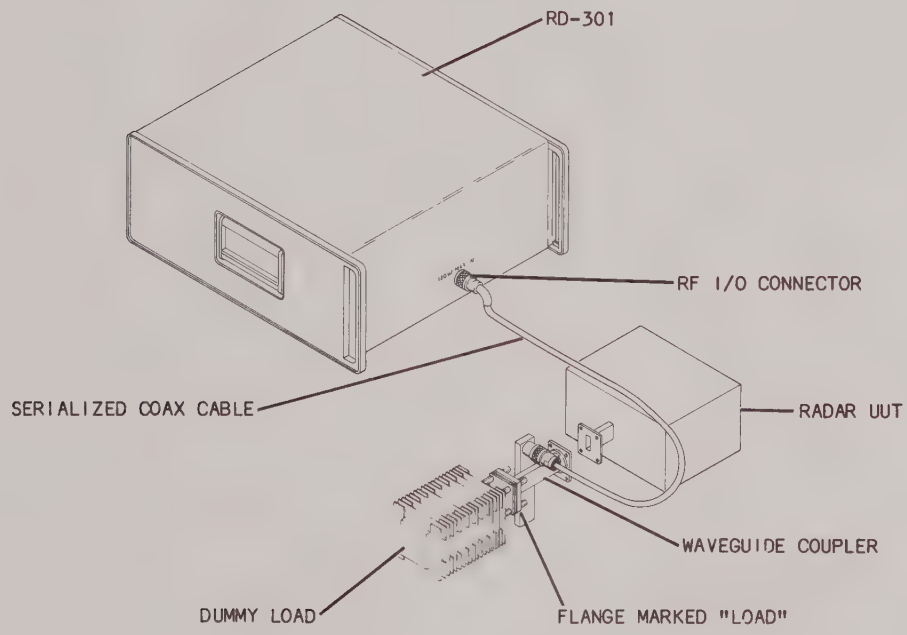
CAUTION: RF INPUT/OUTPUT CONNECTOR (FIGURE 1) TRANSMISSION INTO THIS CONNECTOR SHOULD NEVER EXCEED 120 W.

CAUTION: ANY TRANSMISSION FROM R/T UNITS RATED ABOVE 12 kW REQUIRES INSERTION OF APPROPRIATE 10 dB PAD BETWEEN WAVEGUIDE COUPLER AND COAXIAL CABLE CONNECTION.

CAUTION: SERIALIZED ACCESSORIES
CALIBRATION OF TEST SET AND APPROPRIATE TEST RESULTS ARE DEPENDENT ON USE OF SERIALIZED WAVEGUIDE COUPLER AND COAX CABLE FURNISHED WITH RD-301. ANY REPLACEMENT WILL NECESSITATE RECALIBRATION.

CAUTION: THE COAXIAL CABLE IS A PRECISION PIECE OF MICRO-WAVE EQUIPMENT WHICH WILL NOT WITHSTAND ROUGH PHYSICAL USE OR ABUSE.

CAUTION: DUMMY LOAD
THE HIGH POWER WAVEGUIDE TERMINATION MUST BE ATTACHED TO WAVEGUIDE COUPLER FLANGE MARKED "LOAD" BEFORE PLACING INTO OPERATION (SEE FIGURE 3).



RD-301/UUT Interface
Figure 3

D. Operating Setup

To interface RD-301 Test Set and unit-under-test (UUT), take following steps (see Figure 3):

(1) Connect waveguide coupler to UUT R/T antenna port.

(2) Connect one end of serialized coaxial cable to waveguide coupler.

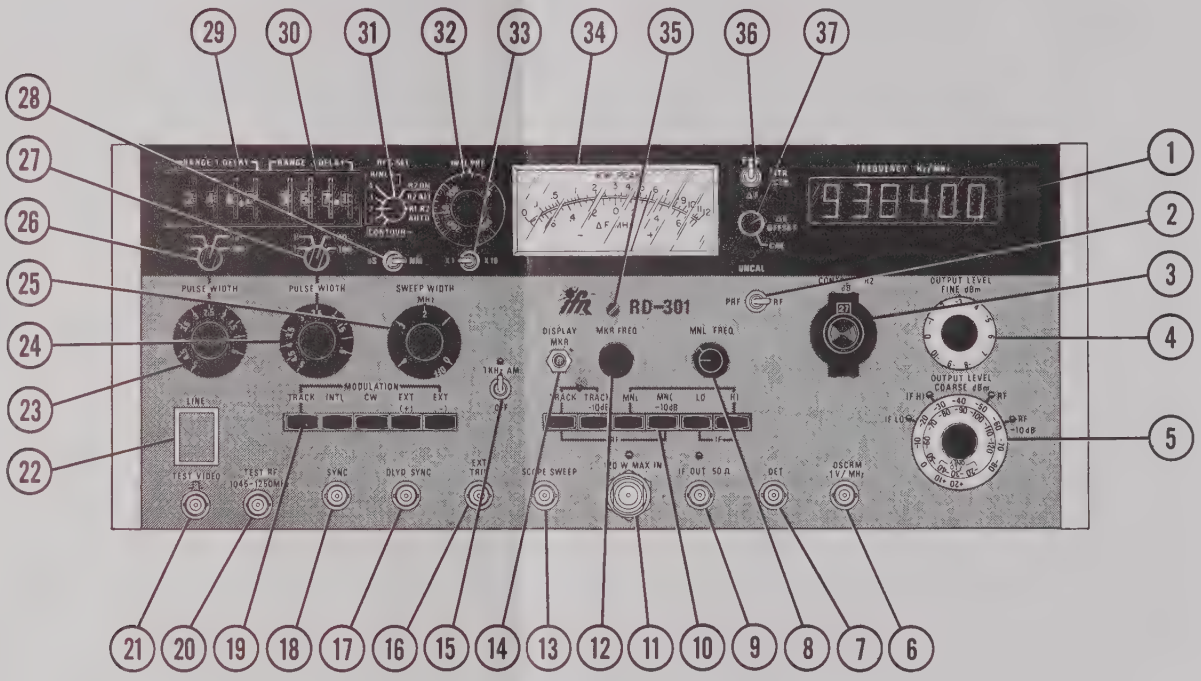
(3) Insure Dummy Load is attached to waveguide coupler flange marked "LOAD".

(4) If UUT R/T unit is rated above 12 kW (up to 120 kW), insert 10 dB pad between coaxial cable and waveguide coupler.

NOTE: KW PEAK readings with 10 dB pad inserted are then read with a factor of "times 10". Power Meter full scale is then 120 kW peak.

(5) Connect serialized coaxial cable to RF Input/Output Connector on Test Set.

2. Description of Controls, Connectors and Indicators



RD-301 Front Panel
Figure 4

(1) FREQUENCY (Hz/MHz) Digital Display
(2) PRF/RF Switch
(3) CONTOUR/R2 (dB) Control
(4) OUTPUT LEVEL FINE (dBm) Control
(5) OUTPUT LEVEL COARSE (dBm) Control*
(6) DSCRM (.1V/MHz) Connector
(7) DET Connector
(8) MNL FREQ Controls
(9) IF OUT (50Ω) Connector*
(10) RF/IF MODE Pushbutton Switches*
(11) RF INPUT/OUTPUT Connector (120 W MAX IN)*
(12) MKR FREQ Controls
(13) SCOPE SWEEP Connector
(14) DISPLAY MKR Switch
(15) 1 kHz AM Switch*
(16) EXT TRIG Connector
(17) DLYD SYNC Connector
(18) SYNC Connector
(19) MODULATION MODE Pushbutton Switches
(20) TEST RF (1045-1250 MHz) Connector
(21) TEST VIDEO Connector
(22) LINE Switch
(23) PULSE WIDTH Control (RANGE 1)
(24) PULSE WIDTH Control (RANGE 2)
(25) SWEEP WIDTH MHz Control
(26) PULSE WIDTH MULTIPLIER Control (RANGE 1)
(27) PULSE WIDTH MULTIPLIER Control (RANGE 2)
(28) µS/NM Switch
(29) RANGE 1 DELAY Thumbwheel Switches
(30) RANGE 2 DELAY Thumbwheel Switches
(31) RNG SEL Switch*
(32) INTL PRF Control
(33) X1/X10 INTL PRF Switch
(34) PANEL Meter
(35) PANEL METER ZERO Control
(36) MTR FCTN Switch
(37) ΔF OFFSET Control*

* Light Emitting Diode (LED) Indicators, associated with control or switch, indicate that particular function is active. LED indicator is explained further under description of control or switch, where necessary.

A. RD-301 Front Panel

(1) FREQUENCY (Hz/MHz) Digital Display
Six digit display of the PRF, IF or RF frequencies as selected by PRF/RF Switch (2) (see Table 1). Marker frequency displayed when DISPLAY MKR Switch (14) is depressed.

(2) PRF/RF Switch
Toggle switch selects function displayed on Digital Display (1). (See Table 1.)

SWITCH POS (2)	MODE SELECTION (10)/(19*)	DIGITAL DISPLAY (1)
PRF	TRACK/TRACK (-10 dB)	UUT Transmitter PRF
PRF	INT *	RD-301 Internal Oscillator PRF
PRF	EXT *	External Trigger Signal PRF
RF	IF LO	IF Signal Generator
RF	IF HI	IF Signal Generator
RF	IF LO/DISPLAY MKR Sw	IF Marker Frequency
RF	IF HI/DISPLAY MKR Sw	IF Marker Frequency
RF	RF TRACK/TRACK (-10 dB)	Signal Generator/UUT Transmitter Frequency
RF	RF MNL/MNL (-10 dB)	Signal Generator Frequency

PRF/RF Display Selections
Table 1

(3) CONTOUR/R2 (dB) Control
Used to alter output level beyond that set by OUTPUT LEVEL Controls (4 & 5). Activated when RNG SEL Control (31) is in Contour position or any R2 position. Inner knob controls in 1 dB steps (0-9). Large outer knob controls in 10 dB steps (0-50). Selection appears in small viewing window at top center of control.

NOTE: When operating CONTOUR/R2 (dB) Control (3) in earlier RD-301 models, operator must observe RF FREQUENCY Digital Display (1) while in MNL operation. CONTOUR/R2 Control might pull RF Frequency.

Contour Selection: Active when RNG SEL Control (31) is in CONTOUR position. Control permits boost of RF level up to 20 dB above the selected output level (Controls 4 & 5). Any boost selected above 20 dB will produce minimal or no additional boost. Applies only to OUTPUT LEVEL settings (Controls 4 & 5) of -75 to -127 dBm.

R2 Selections: Active when RNG SEL Control (31) is in any of the three "R2" positions. Control additionally attenuates RANGE 2 DELAY (30) reply from 0 to -59 dB referenced to OUTPUT LEVEL settings (Controls 4 & 5) selected for RANGE 1 DELAY (29) reply.

(4) OUTPUT LEVEL FINE (dBm) Control
Decreases RF or IF output level from 0 to -10 dB with reference to level set at COARSE dBm Control (5). Stepped at 1 dB intervals.

(5) OUTPUT LEVEL COARSE (dBm) Control *
Varies RF or IF output level in 10 dB stepped increments. Affects RANGE 1 and RANGE 2 (29 & 30) levels in association with FINE dBm Control (4). The red and green scales on knob are referenced to mode selected at RF/IF Mode (10) as indicated by red or green LED and associated index mark. The RF output level is calibrated only down to -127 dBm as selected on the red scale. (See Table 2.)

* LED Indicators: Provide reference to selected active mode (at RF/IF MODE (10)) and appropriate scale on knob as indicated by color of light and scale. (See Table 2.)

LED INDICATOR	COLOR	SCALE	MODE
IF LO	RED	RED	IF LO
IF HI	GREEN	GREEN	IF HI
RF	RED	RED	RF TRACK/ RF MNL
RF (-10 dB)	RED	RED	RF TRACK (-10 dB)/ RF MNL (-10 dB)

RF/IF MODE Indicator Reference
Table 2

(6) DSCRM (.1V/MHz) Connector (Discriminator)
Allows monitoring of transmitter frequency versus time characteristics on an external oscilloscope. Calibration factor is 0.1V/MHz when terminated in 50 ohms at oscilloscope. 5 µs system reference pulse occurs approximately 15 µs after transmitter pulse. The reference voltage corresponds to the displayed RF frequency.

(7) DET Connector (Detector)
Output for displaying transmitter pulse shape characteristics on external oscilloscope. Should be terminated in 50 ohms at scope for best pulse fidelity.

(8) MNL FREQ Controls (Manual)
Coarse (outer knob) and fine (inner knob) manual adjustment of signal generator frequency for RF MNL, RF MNL (-10 dB), IF LO and IF HI modes selected at RF/IF Mode (10). Shown at Digital Display (1).

(9) IF OUT (50Ω) Connector*
Provides for 50 ohm output of IF signal generator. Signal level is controlled by OUTPUT LEVEL Controls (4 & 5).

* LED indicates IF output available.

(10) RF/IF MODE Pushbutton Switches*
Six pushbutton switches enable selection of RF or IF operating modes. Output is varied by Level Controls (4 & 5). Table 3 shows frequency, index and mode relationship. Selection of specific mode will cause related LED at OUTPUT LEVEL COARSE Control (5) to light, indicating appropriate scale to use.

TRACK*
RF signal generator acquires and tracks UUT transmitter frequency signal entering at RF I/O Connector (11). (Do not select "INTL" at MOD MODE Sw (19) at same time as "TRACK" at RF/IF (10) as unit will attempt to respond to two different sources.)

TRACK (-10 dB)*
Used for R/T units above 12 kW (up to 120 kW) peak power output. Similar to TRACK mode but only used with external 10 dB coaxial attenuator inserted at waveguide coupler.

NOTE: During TRACK operations, operator should not generate a return while UUT transmitter is operating, as this may cause tracking inaccuracies at high generator levels (above -75 dBm). To avoid a possible tracking error, operator should select a range delay greater than the UUT transmitter pulse width.

* LED indicates Test Set RF signal generator system has acquired and is tracking UUT transmitter frequency.

MNL (Manual)
RF signal generator frequency controlled by MNL FREQ Control (8). Output is calibrated at R/T unit with serialized coax cable and waveguide coupler.

MNL (-10 dB)
Used for R/T units above 12 kW (up to 120 kW) peak power output. Similar to MNL mode but only used with external 10 dB coaxial attenuator inserted at waveguide coupler.

IF LO
IF signal generator activated in low power range (-20 to -132 dBm). MNL FREQ Control (8) varies IF frequency from 20 to 70 MHz.

IF HI
IF signal generator activated in high power range (+20 to -92 dBm). MNL FREQ Control (8) varies IF frequency from 20 to 70 MHz.

RF/IF MODE	FREQ CONTROL	LEVEL CONTROL INDEX
TRACK	UUT Signal	RF
TRACK (-10 dB)	UUT Signal	RF (-10 dB)
MNL	MNL FREQ	RF
MNL (-10 dB)	MNL FREQ	RF (-10 dB)
IF LO	MNL FREQ	IF LO
IF HI	MNL FREQ	IF HI

RF/IF MODE Reference
Table 3

(11) RF INPUT/OUTPUT (I/O) Connector (120 W MAX IN) *
Input/Output connector couples RD-301 to UUT at antenna waveguide port. Output is calibrated at R/T unit using serialized coax cable and waveguide coupler furnished with test set. Output level is sum of settings of OUTPUT LEVEL COARSE (5) and OUTPUT LEVEL FINE (4) controls, and if applicable, CONTOUR/R2 Control (3).

* LED indicates signal is available at RF I/O Connector.

(12) MKR FREQ Control (Marker)
Permits adjustment of IF marker frequency when DISPLAY/MKR Switch (14) is depressed.

(13) SCOPE SWEEP Connector
Approximately 5 volt peak-to-peak 100 Hz ramp output for horizontal drive to an external oscilloscope during IF sweep tests.

(14) DISPLAY MKR Switch
Momentary contact switch depressed to add marker signal (approximately -20 dBc) to the IF output and also display marker generator frequency at Digital Display (1). Used with MKR FREQ Control (12) which adjusts IF marker frequencies.

(15) 1 KHz AM Switch *
On/Off toggle switch used to add 30% AM (1 KHz ±100 Hz) to RF output.

* LED indicates function is active.

(16) EXT TRIG Connector (External)
Input connector for external 2 to 25 volt peak pulse or sine wave used to trigger start of range delay replies in EXT (+) and EXT (-) modulation modes (19).

(17) DLYD SYNC Connector (Delayed)
Output to external oscilloscope, providing delayed synchronized pulse which has leading edge coincident with leading edge of range reply pulse.

(18) SYNC Connector
Provides leading edge output to external oscilloscope coincident with start of each range delay (i.e., simultaneous with leading edge of UUT transmitter pulse).

(19) MODULATION MODE Pushbutton Switches
Five pushbutton selectors designate manner in which simulated replies are initiated, or enable a continuous wave RF or IF output.

TRACK
Starts simulated reply delays coincident with 50% point of leading edge of transmitter pulse from R/T unit.

INTL (internal)
Starts simulated reply delays under control of internal PRF oscillator which initiates range reply system. Used in conjunction with INTL PRF Control (32) for triggering circuit under test.

CW
Selects continuous wave RF or IF outputs furnished at RF I/O Connector (11), and IF OUT (9).

EXT (+) (external)
Starts reply delay at positive edge of a 2 to 25 volt peak pulse or on positive half of sine wave input applied to EXT TRIG Connector (16).

EXT (-) (external)
Starts reply delay at negative-going edge of a 2 to 25 volt peak pulse on negative half of sine wave input applied to EXT TRIG Connector (16).

(20) TEST RF (1045-1250) MHz Connector
Allows for input of L-band RF test signal to RD-301 Test Set for convenient calibration and verification of tracking circuits.

(21) TEST VIDEO Connector
Used in conjunction with TEST RF Connector (20) for input of external signal to facilitate discriminator testing and calibration.

(22) LINE Switch
On/Off pushbutton switch for application of power to RD-301 Test Set. Illuminated when power applied.

(23) PULSE WIDTH Control (RANGE 1)
Provides for pulse width adjustment of RANGE 1 DELAY (29) simulated reply. Selector is adjustable from .5 to 5 µs; variable from .05 to 500 µs depending on multiplier factor selected at PULSE WIDTH MULTIPLIER Control (26).

(24) PULSE WIDTH Control (RANGE 2)
Provides for pulse width adjustment of RANGE 2 DELAY (30) simulated reply. Selector is adjustable from .5 to 5 µs; variable from .05 to 500 µs depending on multiplier factor selected at PULSE WIDTH MULTIPLIER Control (27).

(25) SWEEP WIDTH MHz Control
Controls peak-to-peak sweep width (in MHz) of IF system. Sweep rate is 100 Hz. Has detent "OFF" position.

(26) PULSE WIDTH MULTIPLIER Control (RANGE 1)
Used to select multiplication factor (.1, 1, 10 or 100) for the value set at PULSE WIDTH Control (23) for Range 1.

(27) PULSE WIDTH MULTIPLIER Control (RANGE 2)
Used to select multiplication factor (.1, 1, 10 or 100) for the value set at PULSE WIDTH Control (24) for Range 2.

(28) µs/NM Switch
Toggle switch selects type of unit (µs or NM) for simulated reply delays for both Range 1 and Range 2.

(29) RANGE 1 DELAY THUMBWHEEL Switches
Four thumbwheel switches for selection of delay for Range 1 simulated reply. Selectable from 0.1 to 999.9 in either µs or NM depending on position of µs/NM Switch (28). A residual time delay (nominally 0.1 µs) is added to all selected delays. Manner of delay is controlled by Modulation Mode (19).

(30) RANGE 2 DELAY THUMBWHEEL Switches
Four thumbwheel switches for selection of delay for Range 2 simulated reply. Selectable from 0.2 to 999.9 in either µs or NM depending on position of µs/NM Switch (28). Functions similarly to Range 1 Delay except that a residual time delay (nominally 0.4 µs) is added to all selectable delays.

(31) RNG SEL Switch * (Range Select)
Nine position rotary switch provides variations of the simulated reply. Selects Contour, or number of range rings (1-5), or activation of second range delay.

CONTOUR *
Activates contour circuits providing selectable 0 to 20 dB boost above level set by OUTPUT LEVEL Controls (4 & 5). Controlled by CONTOUR/R2 Control (3). Range 1 is always active, as is Ring 1. Boost applies to output level settings from -75 to -127 dBm.

* LED indicates contour function is active.

RINGS 1 through 5
Allow selection of number of equally spaced simulated replies for gauging R/T range accuracy. Minimum range for Rings 2 through 5 is 0.3 µs or NM. Setting of RANGE 1 DELAY (29) establishes ring 1 delay and distance between all succeeding rings (equidistant).

R2 ON
Activates Range 2 in addition to Range 1. Range 1 reply is attenuated by OUTPUT LEVEL Control settings (4 & 5). Range 2 is attenuated by CONTOUR/R2 dB Control (3). Variable from 0 to -59 dB.

R2 ALT
Activates Range 1 reply every time and Range 2 reply every other time. Range 2 output attenuation is selectable at CONTOUR/R2 Control (3) from 0 to 59 dB below Range 1 output level.

R1/R2 AUTO
A pre-selected threshold for the transmitter pulse width is established for this function. This threshold (adjustable internally from 0.2 µs to 1.0 µs*) interacts with detected pulse width. Only Range 1 will respond if detected pulse width is below threshold. If above, only Range 2 will respond.

NOTE: Minimum range delay for both Range 1 and 2 must be selected greater than threshold. If Range 1 Delay is set below threshold, Range 1 will always respond. If Range 2 Delay is below threshold, Range 2 will never respond.

* See Appendix A for procedure to set threshold if adjustment is necessary. (Factory setting is 0.4 µs.)

(32) INTL PRF Control (Internal)
Regulates pulse repetition frequency oscillator of RD-301 for INTL modulation mode (19) displayed at Digital Display (1). Triggers circuit under test. PRF is continuously variable between 50 and 500 Hz or from 500 to 5000 Hz depending on position of X1/X10 Switch (33).

(33) X1/X10 INTL PRF Switch
Toggle switch allows selection of multiplication factor (X1 or X10) used with INTL PRF Control (32).

(34) PANEL Meter
Indicates peak power of UUT transmitter, or frequency offset between UUT transmitter and RD-301 Test Set signal generator. Function is selected by MTR FCTN Switch (36).

KW PEAK Scale
Indicates peak RF power of transmitter at RF Connector (11) over a .1 to 12 kW range. MTR FCTN Switch (36) must be in PWR position. For units above 12 kW (up to 120 kW), external 10 dB coaxial attenuator must be connected to waveguide coupler output (this will require reading the scale with a factor of "times 10"). Power is calibrated and accuracy specified from 1.0 to 12 kW.

NOTE: Correct calibration is dependent on use of serialized waveguide coupler and coax cable furnished with RD-301 Test Set. If replacement coupler or cable is used, Test Set must be recalibrated.

ΔF-MHz Scale
Displays amount of offset between UUT transmitter and Test Set signal generator frequencies for RF TRACK modes. Offset is adjustable by ΔF OFFSET Control (37). MTR FCTN Switch (36) must be in ΔF position.

(35) PANEL METER ZERO Control
Inset screw for mechanical alignment of the Panel Meter needle with Test Set power off. For use only in Calibration procedure (per Maintenance Manual).

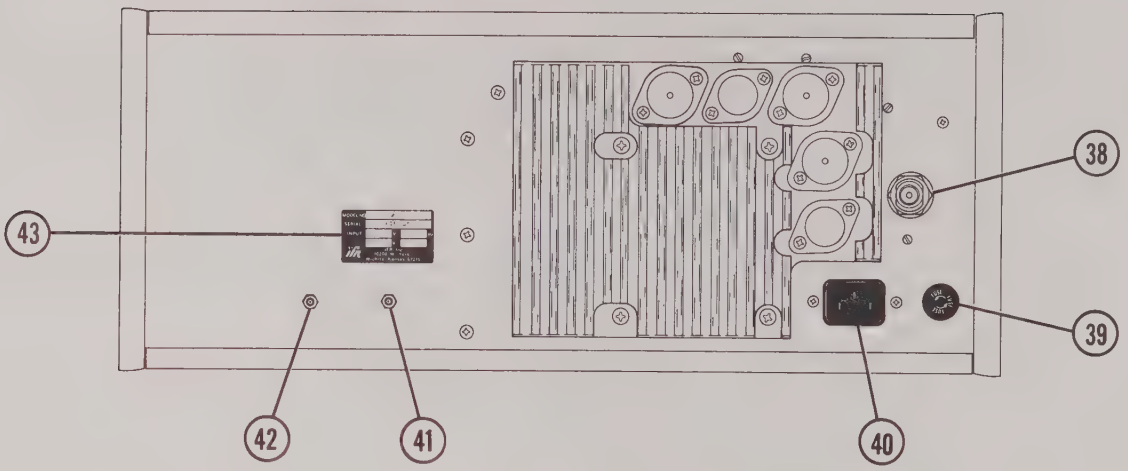
(36) MTR FCTN Switch (Meter Function)
Toggle switch selects display mode (Peak Power or ΔF-MHz Scale) of PANEL METER (34) (see Table 4).

POSITION	READING
PWR	UUT Transmitter peak RF power
ΔF	Frequency difference: UUT Transmitter/Test Set Signal Generator

PWR/ΔF Selection
Table 4

(37) ΔF OFFSET Control
Allows offset of RF signal generator from UUT transmitter frequency by up to ±0.75 MHz in RF TRACK modes. In TRACK modes, Test Set continues tracking transmitter with offset introduced. Frequency offset is removed when ΔF Offset Control is in CAL (detent) position. Offset is displayed on ΔF scale of PANEL METER (34) when MTR FCTN Switch (36) is in ΔF position. The meter does not operate unless the Test Set is tracking UUT transmitter.

* LED UNCAL indicator comes on to indicate ΔF Control is not in CAL (detent) position and that system (in TRACK Mode) is tracking magnetron frequency with offset determined by ΔF OFFSET Control.



RD-301 Rear Panel
Figure 5

B. RD-301 Rear Panel

(38) SPECTRUM ANALYZER Connector
Provides radar signal attenuated by 56 to 68 dB for a Spectrum Analyzer to check X-Band front end.

(39) FUSE HOLDER
Holds fuse for AC power operation. (1 amp slow blow fuse for 115 VAC and 1 amp fast blow for 230 VAC operation.)

(40) AC INPUT Connector
Input connector for AC power source. 105 - 125 VAC and 210 - 250 VAC; AC 50 to 400 Hz; less than 150 Watts.

(41) AUX RF OUT Connector
Provides for auxiliary RF output from X-Band front end for general signal generator applications and for calibrating tracking accuracy of Test Set at X-Band. Output level controlled by OUTPUT LEVEL FINE and COARSE Controls (4) and (5).

(42) VCO OUT Connector
Test connector to provide a sample of VCO for testing tracking accuracy at L-Band. (Not included on earlier sets.)

(43) DATA Plate
Contains Rating/Model/Serial information for particular RD-301.

3. Performance Checks

Following are a series of quick functional checks of the RD-301 front panel controls and indicators.

A. RF

(1) Set listed controls as indicated:

CONTROL/SWITCH	SETTING
LINE Switch (22)	- ON
MODULATION MODE (19)	- INTL
RF/IF MODE (10)	- MNL
PRF/RF Switch (2)	- RF

(2) Turn MNL FREQ Controls (8) ccw for minimum reading.

(3) Observe FREQUENCY Digital Display (1). Display should register 9295 MHz or less.

(4) Turn MNL FREQ Controls (8) cw for maximum reading.

(5) Observe FREQUENCY Digital Display (1). Display should register 9500 MHz or more.

B. IF

(1) Hook up a Frequency Counter (capable of a range from 5 Hz to 100 MHz) to IF OUT Connector (9).

(2) Set listed controls as indicated:

CONTROL/SWITCH	SETTING
MODULATION MODE (19)	- CW
RF/IF MODE (10)	- LO
OUTPUT LEVEL FINE Control (4)	- 0
OUTPUT LEVEL COARSE Control (5)	- IF LO value of 20

(3) Observe that Digital Display (1), with MNL FREQ Control (8) at maximum cw, registers 70 MHz or above.

(4) Verify that Frequency Counter registers same value.

(5) Turn MNL FREQ Control (8) ccw to minimum reading, stopping at 45 MHz reading.

(6) Verify that Frequency Counter registers same value as Digital Display (1) at 45 MHz reading. Observe that both Digital Display (1) and Frequency Counter register minimum reading of 20 MHz or less.

(7) Select "HI" on RF/IF MODE Pushbutton Switches (10).

(8) Observe that minimum and maximum readings on Digital Display (1) are the same as for "LO" procedure above. Verify that Frequency Counter registers the same values.

C. PRF

(1) Connect Frequency Counter to RD-301 SYNC Connector (18).

(2) Set listed controls as indicated:

CONTROL/SWITCH	SETTING
MODULATION MODE (19)	- INTL
PRF/RF Switch (2)	- PRF
X1/X10 Switch (33)	- X1
INTL PRF Control (32)	- 50 PRF

(3) Observe that Digital Display (1) registers ≈ 50 PRF.

(4) Verify that Frequency Counter registers same value.

(5) Turn INTL PRF Control (32) cw to maximum value. Observe that Digital Display (1) registers an increase through the range to 500 PRF or above.

(6) Verify that Frequency Counter registers same value as Digital Display (1) through full range.

(7) Select "X10" at X1/X10 switch (33).

(8) Observe that Digital Display (1) registers 5000 PRF or more. Verify Frequency Counter registers same value.

(9) Turn INTL PRF Control (33) ccw full range and observe that Digital Display (1) registers a decrease to 500 PRF or less. Verify that Frequency Counter registers same value as Digital Display (1) throughout range.

(10) Disconnect Frequency Counter from RD-301.

(11) Select all other pushbutton switches, other than "INTL", at MODULATION MODE Pushbutton Switches (19), in sequence. Observe that Digital Display (1) registers "0" in all Modes other than "INTL".

D. RANGE 1/RANGE 2

(1) Connect Dual Trace Oscilloscope (Tektronix 465 or equivalent) to RD-301. Channel 1 to DLYD SYNC Connector (17) and Channel 2 to SYNC Connector (18).

(2) Set RD-301 Controls as indicated:

CONTROL/SWITCH	SETTING
MODULATION MODE (19)	- INTL
PRF/RF Switch (2)	- PRF
INTL PRF Control (32)	- 500
X1/X10 Switch (33)	- X1
PULSE WIDTH Control (RG 1) (23)	- 20 µs
PULSE WIDTH MULTIPLIER CONTROL (RG 1) (26)	- 1
RANGE 1 DELAY (29)	- Ø
RNG SEL Switch (31)	- 1 Ring
µS/NM Switch (28)	- µS

(3) Set up Oscilloscope as indicated:

- Trigger on Channel 2
- Channel 1: V/DIV of .5
- Channel 2: V/DIV of 2
- .2 mS/DIV
- Both Channels on DC
- Adjust so Channel 1 is clearly visible on top half of screen and Channel 2 is clearly visible on bottom half.
- Adjust Horizontal Control so sync pulse is on far left graticule of screen.

(4) Dial in 200.0 µs on RANGE 1 DELAY Thumbwheel Switches (29). Verify that RG 1 reply pulse on Oscilloscope screen moves one major division to right. Take all measurements from leading edge of the pulse.

(5) On RNG SEL Switch (31), select as indicated below and verify results as indicated:

Ring 2 - Ring 2 reply pulse appears one major division to right of Ring 1.
Ring 3 - Ring 3 reply pulse appears one major division to right of Ring 2.
Ring 4 - Ring 4 reply pulse appears one major division to right of Ring 3.
Ring 5 - Ring 5 reply pulse appears one major division to right of Ring 4.

(6) Select various values on RANGE 1 DELAY Thumbwheel Switches (29) and verify that Range 1 reply rings on Oscilloscope change accordingly.

(7) Select "R2 ON" at RNG SEL Switch (31).

(8) Set Range 2 controls as indicated:

CONTROL/SWITCH	SETTING
PULSE WIDTH Control (RG 2) (24)	- 20 µs
PULSE WIDTH MULTIPLIER Control (RG 2) (27)	- 1
RANGE 2 DELAY Thumbwheel Switches (30)	- 400.0 us

(9) Verify that Range 2 reply pulse registers on Oscilloscope screen at second major graticule from left.

(10) Select various values on RANGE 2 DELAY Thumbwheel Switches (30) and verify that Range 2 reply pulse varies accordingly.

(11) Set RD-301 Controls as indicated:

CONTROL/SWITCH	SETTING
RNG SEL Switch (31)	- 1 Ring
PULSE WIDTH Control (RG 1) (23)	- 3 µs
PULSE WIDTH MULTIPLIER Control (RG 1) (26)	- .1

(12) Set Oscilloscope for .1 us per DIV. Trigger on Channel 1.

(13) Verify the pulse width is .3 us wide at 50% voltage points.

(14) Change PULSE WIDTH MULTIPLIER Control (RG 1) (26) to "1" and set Oscilloscope to 1 us per DIV.

(15) Verify pulse width is 3 µs wide at 50% voltage points.

(16) Change PULSE WIDTH MULTIPLIER Control (RG 1) (26) to "10" and set Oscilloscope to 10 us per DIV.

(17) Verify pulse width is 30 µs wide at 50% voltage points.

(18) Change PULSE WIDTH MULTIPLIER Control (RG 1) (26) to "100" and set Oscilloscope to 100 us per DIV.

(19) Verify pulse width is 300 µs wide at 50% voltage point.

(20) Select "R2 ON" at RNG SEL Switch (31) and repeat steps (10) - (17) for Range 2.

(21) Disconnect Oscilloscope from RD-301.

E. MTR FCTN

(1) Connect Pulse Generator (Wavetek 145 or equivalent) to Channel 1 of Oscilloscope (into 50 ohms).

(2) Set Pulse Generator for the following:

5 µs pulse width
500 PRF
+5V peak

(3) Disconnect Pulse Generator from Oscilloscope and connect to TEST VIDEO Connector (21) on RD-301.

(4) Select "PWR" at MTR FCTN Switch (36) on RD-301.

(5) At +5V peak observe .5 to 2 kW reading on RD-301 PANEL Meter (34).

(6) With Pulse Generator, vary pulse height from +5V to Ø, observing PANEL Meter (34) on RD-301. Verify that power reading drops to Ø.

(7) Return power to reading achieved at step (7).

F. R1/R2 AUTO

(1) Hook-up equipment as follows:

RD-301	Oscilloscope	Pulse Generator
DET Connector (7)	Channel 1 (DC)*	--
DYLD SYNC Connector (17)	Channel 2 (DC)*	--
SYNC Connector (18)	EXT TRIG	--
TEST VIDEO Connector (21)	--	Output Connector

(2) Adjust Pulse Generator for +3V, 5 µs pulse width and 2000 PRF.

(3) Set Oscilloscope as indicated below:

Time/DIV: 2 µs
Channel 1 V/DIV: 1
Channel 2 V/DIV: 1

*Into 50 ohms

(4) Set RD-301 as indicated:

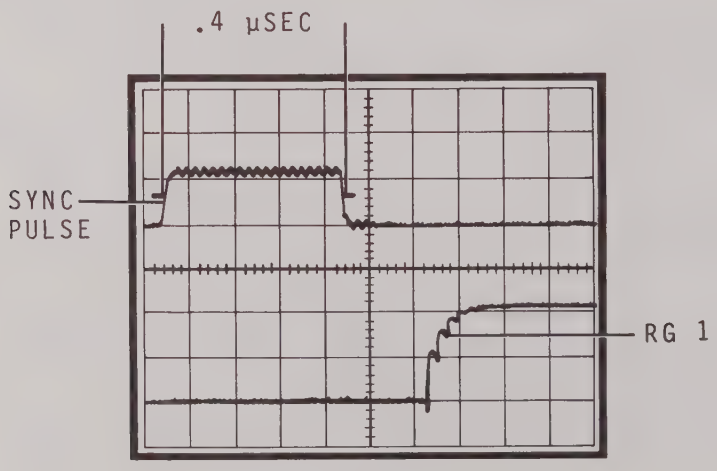
CONTROL/SWITCH	SETTING
PRF/RF Switch (2)	- PRF
RF/IF MODE (10)	- TRACK or MNL
MODULATION MODE (19)	- TRACK
PULSE WIDTH Control (RG 1) (23)	- 1 µs
PULSE WIDTH Control (RG 2) (24)	- 3 µs
PULSE WIDTH MULTIPLIER Control (RG 1) (26)	- 1
PULSE WIDTH MULTIPLIER Control (RG 2) (27)	- 1
µs/NM Switch (28)	- µs
RANGE 1 DELAY (29)	- .5 µs
RANGE 2 DELAY (30)	- 11.00 µs
RNG SEL Switch (31)	- R1/R2 AUTO

(5) Verify RG 2 reply pulse is present on Oscilloscope Channel 2, 11 µs from sync pulse.

(6) Adjust Pulse Generator pulse width to point that RG 1 appears (at Threshold). Set Oscilloscope Sweep to .1 µs/DIV.

(7) Measure Channel 1 image for Threshold width (.4 µs is factory setting). See Figure 6.

(8) Disconnect test hookups.



R1/R2 AUTO Threshold Measurement
Figure 6

G. MKR

(1) Set RD-301 Controls as indicated:

CONTROL/SWITCH	SETTING
PRF/RF Switch (2)	- RF
RF/IF MODE (10)	- LO

(2) Depress DISPLAY MKR Switch (14) and observe that frequency displayed at Digital Display (1) changes.

(3) With DISPLAY MKR Switch (14) depressed, turn MKR FREQ Control (12) cw and observe that maximum reading at Digital Display (1) registers 70 MHz or above.

(4) With DISPLAY MKR Switch (14) depressed, turn MKR FREQ Control (12) ccw and observe minimum reading at Digital Display (1) registers 20 MHz or less.

4. General Operating Procedures

A. General

This section contains general information for operation of the RD-301 Radar Test Set. These are introductory measures. Complete utilization for testing is dependent on UUT manufacturer's procedures. Technician should be thoroughly familiar with information in the preceding pages of this manual prior to operation of the Test Set.

(1) Placing RD-301 Into Operation

Placing the RD-301 into operation is the process of interfacing the RD-301 with UUT and any associated test equipment, applying power, and following test procedures prescribed by manufacturer of UUT. Use the steps provided in this section as applicable.

(2) Interface

Interface is accomplished as described in Section 2, paragraph 1, Installation. Take due regard for all "CAUTION", "WARNING" and "NOTE" entries during operation. Be aware of safety requirements regarding radar set being tested. Unless otherwise indicated, the following detailed procedures utilize the hook-up as shown in Figure 3.

B. Procedures

Initial test set-up is as shown in Figure 3.

(1) UUT Peak Power

Radar R/T unit peak pulse power output is measured on PANEL Meter (34).

(a) Set MTR FCTN Switch (36) to "PWR" position and observe PANEL Meter (34) for reading.

(2) Frequency/Pulse Repetition Frequency (PRF)

Radar R/T unit PRF or unit transmitter frequency is measured and displayed on Digital Display (1).

(a) Select TRACK* on both RF/IF MODE Pushbuttons (10) and MODULATION MODE Pushbuttons (19).

* Asterisk following "TRACK" throughout this section (General Operating Procedures) indicates operator should verify LED is lit, indicating TRACK function is operating.

(b) Verify red TRACK LED is illuminated.

(c) Insure ΔF OFFSET (37) is in CAL (detent).

(d) Set PRF/RF Switch (2) to either PRF or RF as appropriate.

(e) Observe indicated frequency or PRF on Digital Display (1).

(3) Modulation/Timing

Modulation procedures provide a test of UUT timing with regard to pulse transmission and ranging, and reply detection. Test Set generates precision range rings with which to compare and check rings displayed by UUT indicator.

(a) Set controls as shown in Table 5.

CONTROL/SWITCH	SETTING
RF/IF MODE (10)	TRACK*
MODULATION MODE (19)	TRACK
MTR FCTN (36)	ΔF
ΔF OFFSET (37)	CAL
μs/NM (28)	NM
PULSE WIDTH (23 & 26)	Less than 1/5 Range Delay**
RANGE 1 DELAY (29)	As desired***
RNG SEL (31)	# of Range Rings on UUT indicator

Range Ring Check Test Settings
Table 5

(b) Adjust RANGE 1 DELAY (29) until leading edge of Test Set reply is superimposed over indicator range rings.

(c) Check distance between range rings as indicated on RANGE 1 DELAY (29) selector and compare to specified distance between range rings on UUT indicator.

** If pulse width is selected too wide, the reply will not show or presentation will be distorted when more than one range ring is selected at RNG SEL Control (31).

*** Selected range delay should be greater than UUT transmitter pulse width.

(4) Amplitude/Sensitivity - Minimum Discernible Signal

Procedures provide for check of UUT amplitude control accuracy, as well as detection sensitivity.

(a) Control reply signal through RF I/O Connector (11) by means of OUTPUT LEVEL COARSE (dBm) Control (5) and OUTPUT LEVEL FINE (dBm) Control (4).

(b) For measurement of UUT receiver sensitivity by determining Minimum Discernible Signal (MDS) or Tangential Sensitivity Signal (TGS), set controls as shown in Table 6.

CONTROL/SWITCH	SETTING
RF/IF MODE (10)	TRACK*
MODULATION MODE (19)	TRACK
PULSE WIDTH (RANGE 1) (23)	As desired**
PULSE WIDTH MULTIPLIER (26)	As desired
RANGE 1 DELAY (29)	As desired (past STC)
RNG SEL (31)	Ring 1
ΔF OFFSET (37)	CAL

Receiver Sensitivity Test Settings
Table 6

** Reply will not show if pulse width selected is too narrow.

(c) Connect Oscilloscope to monitor the receiver video. Trigger Oscilloscope from DLYD SYNC Connector (17) on Test Set.

(d) Adjust Test Set output (4) and (5) until Oscilloscope response (or video) is just discernible (MDS) or simulated reply pulse rises just above noise level (TGS).

(e) Combination of readings from OUTPUT LEVEL Controls (4) and (5) is recorded as receiver sensitivity.

(5) Amplitude Sensitivity - Contour Threshold

(a) For determination of output level at which UUT achieves contour threshold, set controls as shown in Table 7.

CONTROL/SWITCH	SETTING
RF/IF MODE (10)	TRACK*
MODULATION MODE (19)	TRACK
MTR FCTN (36)	ΔF
ΔF OFFSET (37)	CAL
RNG SEL (31)	CONTOUR
RANGE 1 DELAY (29)	Beyond STC
OUTPUT LEVELS (4 & 5)	MDS
CONTOUR/R2 (dB) (3)	Adjust for threshold per procedures below

Contour Threshold Test Settings
Table 7

NOTE: CONTOUR/R2 (dB) Control (3) additionally controls output level above that set by Controls (4) and (5).

(b) Monitor video on oscilloscope or radar indicator display per radar manufacturer's recommendations or standard practices to check color/intensity.

(c) Adjust CONTOUR/R2 dB Control (3) (0 through 20 dB) for color/intensity until desired contour level is reached. Read level of CONTOUR/R2 (dB) Control (3) for contour threshold.

(6) Video Threshold levels can also be determined by use of CONTOUR/R2 (dB) Control (3).

(7) Range 2 Delay/Dual Target Resolution

A second range delay can be activated by selection of R2 positions on RNG SEL Switch (31). This provides for Dual Target Resolution. The start of the range delay is triggered from leading edge of UUT transmitter pulse.

(a) Set controls as shown in Table 8. Please note specifics of R1/R2 operation in Section 2, paragraph 2 (Controls, Connectors and Indicators) before initiating this procedure.

CONTROL/SWITCH	SETTING
RF/IF MODE (10)	TRACK*
MODULATION MODE (19)	TRACK
µs/NM (28)	µs
PULSE WIDTH (Range 1) (23)	5 µs
PULSE WIDTH MULTIPLIER (26)	X.1
PULSE WIDTH (Range 2) (24)	5 µs
PULSE WIDTH MULTIPLIER (27)	X1
RNG SEL (31)	R2 ON
ΔF OFFSET (37)	CAL
RANGE 1 DELAY (29)	50 µs
RANGE 2 DELAY (30)	60 µs
OUTPUT LEVEL Controls (4 & 5)	Desired output level for Range 1 reply
CONTOUR/R2 (dB) (3)	Desired differential below Range 1 reply

Dual Target Resolution Settings
Table 8

(b) Note that the Range Delay selections will yield a 50.1 µs delay for Range 1 and a 60.4 µs delay for Range 2. Also, if Range 1 pulse width is selected for more than 10 µs, Range 2 reply will overlay Range 1 reply.

(c) Observe indicator for replies of varying width/amplitude.

(d) Change RNG SEL Switch (31) to R2 ALT if UUT manufacturer recommends this test. Test Set will reply with Range 1 for every UUT transmitter pulse and reply with Range 2 for every other (or alternate) UUT transmitter pulse.

(e) Observe that UUT signal processing is according to the manufacturer's requirements.

(f) Change RNG SEL Switch (31) to R1, R2 AUTO if UUT manufacturer recommends this test. Test set will reply with either Range 1 or Range 2 to each UUT transmitter pulse. Range 1 is selected if transmitter pulse is less than threshold. Range 2 is selected if transmitter pulse is greater than threshold. (Threshold is preset at factory to 0.4 µs.)

(g) Observe that UUT signal processing is according to manufacturer's requirements.

NOTE: Minimum range delay for both Range 1 and 2 must be selected greater than threshold. If Range 1 Delay is set below threshold, Range 1 will always respond. If Range 2 Delay is below threshold, Range 2 will never respond.

C. Additional Operational Considerations

(1) RF/IF Operating Modes

Selection of desired RF or IF operating mode is enabled by RF/IF Mode Pushbutton Switches (10). Allows for RF signal generator to be controlled manually or to automatically track UUT magnetron frequency. Also provides for use of IF signal generator in one of two power ranges.

(2) Simulated Returns

MODULATION MODE Pushbutton Switches (19) select type of simulated reply. Also provide for continuous wave RF or IF output.

(3) IF Testing

IF testing can be accomplished using Continous Wave (CW), sweep or pulse modulated generator functions built into Test Set. Pulse modulated generator can be triggered internally by PRF oscillator or by external trigger pulses. Refer to manufacturer's manual for specific testing procedures.

(4) Sensitivity Time Constant (STC) Measurements

Verification of decrease in receiver sensitivity at short range delays can be done with either magnetron trigger or external trigger. If IF pulses are required, connect 50 ohm cable between IF OUT Connector (9) and R/T unit.

(5) Automatic Frequency Control (AFC) Centering

For AFC centering tests, the Test Set is used to track the transmitter frequency and to offset the reply signal frequency while monitoring the radar R/T video or indicator. This is done to determine the -3 dB point frequencies of the receiver and check that they are centered about the transmitter frequency. Use Oscilloscope triggered from DLYD SYNC Connector (17). The ΔF feature is integral to this function (see item 37 in Section 3).

(6) ΔF OFFSET

Provides for an offset of RF signal generator from UUT transmitter frequency (up to ±0.75 MHz) in RF TRACK modes.

(7) IF Marker Signal

Provides for addition of marker signal (approximately -20 dBc) to IF output and display of marker generator frequency at Digital Display (1). Marker generator frequency is adjusted by MKR FREQ Control (12).

(8) Additional Connectors

See descriptions at appropriate item number in Section 3.

SECTION 3 - SPECIFICATIONS

1. Following are the specifications for the RD-301 Radar Test Set.

   A. RF SIGNAL GENERATOR

Variable Mode Frequency:	Continuously variable from 9.295 to 9.500 GHz.
Tracking Mode:	Tracks radar transmitter frequencies 9.295 to 9.500 GHz and transmitter power from 0.1 to 12 kW.

Tracking Accuracy:

Radar Transmitter Pulse Width	Maximum Error
30 - 2 µs	±25 kHz *
<2 - .5 µs	±60 kHz
<.5 - .1 µs	±600 kHz
<.1 - .05 µs	±2 MHz

*(10 kHz typical)

ΔF Mode (during track):	Signal Generator frequency may be offset ±0.75 MHz from tracking frequency for AFC Centering tests. Front Panel Meter reads ΔF offset. Accuracy is ±20 kHz plus 10% of reading.
Output Power:	-50 to -127 dBm in 1 and 10 dB steps calibrated at R/T. Accuracy is ±2 dB.
Contour Boost:	Contour Control provides 0 to 20 dB signal boost above the selected RF Output. Accuracy of Contour Boost is ±1 dB from 9.310 through 9.410 GHz. This boost applies to output attenuator settings of -75 dBm to -127 dBm.
Range Number 2 Attenuation:	0-59 dB ±1.5 dB below the RF Output level of Range One, in 1 dB steps. Minimum RF signal level of Range 2 is -127 dBm.
RF Pulse Width:	.05 µs to 500 µs continuously variable.

RF ON/OFF Ratio:	70 dB minimum
1 kHz AM:	30% AM nominal (1 kHz ± 100 Hz)
Source VSWR at Waveguide Coupler:	1.25:1 maximum

B. IF SIGNAL GENERATOR

Frequency:	Continuously variable from 20 to 70 MHz.
Sweep Width:	Continuously variable from 0 to 4 MHz.
Marker Frequency:	Continuously variable from 20 to 70 MHz.
Power:	+20 to -130 dBm in 1 and 10 dB steps in two ranges; accuracy is ±2.5 dB plus 1% of setting.
Pulse Width:	Continuously variable from 0.5 μs to 500 μs.
ON/OFF Ratio:	48 dB minimum.

C. MODULATION MODES

Track:	PRF same as Radar-Under-Test (50 Hz to 20 kHz).
INTL (Internal):	PRF continuously variable from 50 to 5000 Hz.
CW:	Continuous wave output.
EXT (+), EXT (-):	External synchronization pulse (see INPUTS, EXT TRIG.).

D. RANGE

Range Number 1:	0.1-999.9 μs or nautical miles (NM). Time referenced to the 50% point of leading edge of detected radar transmitter pulse. Residual delay: 0 to 0.2 μs.

Range Number Two:	0.2-999.9 μs or nautical miles (NM). Time referenced to the 50% point of leading edge of detected radar transmitter pulse. Residual delay: 0.3 to 0.5 μs.
Range Accuracy:	Residual delay ±.01% of selected range delay. Range delay is referenced to 12.3589 μs/NM.
Range Modes:	
CONTOUR:	See RF Signal Genertor, Contour Boost.
RINGS 1, 2, 3, 4, 5:	Selectable multiples of Range Number 1.
R2 ON:	Range Number 1 and 2 active.
R2 ALT:	Range Number 2 active every other detected radar pulse.
R1, R2 AUTO:	Either Range Number 1 or Range Number 2 active according to detected radar transmitter pulse width. Threshold selection is internally adjustable from 0.2 μs to 1.0 μs. (Standard setting is 0.4 μs.)

E. FREQUENCY COUNTER

RF:	Displays RF output frequency of generator. Resolution: 10 kHz Accuracy: ±250 kHz
IF:	Displays IF Generator frequency, or marker frequency upon pushbutton command. Resolution: ±1 kHz. Accuracy: .01%
PRF:	Displays pulse repetition frequency. Resolution: 1 Hz Accuracy: ±1 Hz plus .01%

F. POWER METER

Range:	0.1 kW to 12 kW peak standard. (1.0 kW to 120 kW optional*) (10 W to 1200 W optional*) *Optional power ranges include an external 10 dB attenuator not calibrated in the system.
Accuracy:	Calibrated at R/T, ±0.6 dB from 1 kW to 12 kW peak standard.
Load VSWR:	1.25:1 maximum.

G. OUTPUTS

DET (Detector):	Detected radar transmitter signal (into 50 OHM load).
Spectrum Analyzer: (Back Panel)	Attenuated RF sample of radar transmitter signal.
DSCRM: (Discriminator)	Frequency discriminator output. 0.1v/MHz ± 10% (into 50 OHM load).
SYNC (Scope Sync):	Positive polarity pulse simultaneous with radar transmitter pulse in Track Mode, Internal PRF Generator in Internal Mode, or External Trigger in EXT (+) or EXT (-) Mode.
DLYD SYNC (Delayed Sync):	Simultaneous with Range 1 and Range 2 generator pulses.
SCOPE SWEEP:	100 Hz ramp output approximately 5 volt peak-to-peak.
AUX RF OUT (Back Panel):	Auxiliary RF output from X-Band front end.
VCO OUT (Back Panel):	Sample L-Band signal from VCO.

H. INPUTS

EXT TRIG (External Trigger):	AC coupled, either polarity, 2 to 25V peak; 50 Hz to 20 kHz.

I. PHYSICAL CHARACTERISTICS

Power:	105 - 125 VAC, 210 - 250 VAC
	50 to 400 Hz
	150 Watts
Dimensions:	16.7 inches (42.2 cm) wide 7.3 inches (18.5 cm) high 18.4 inches (46.7 cm) deep
Weight:	42 pounds (19 Kg.)
	Waveguide Accessories: 3 pounds (1.4 Kg.)

SECTION 4 - SHIPPING

1. The following information applies to shipping and repacking procedures for the RD-301.

   A. Shipping Information

      IFR test sets returned to factory for calibration, service or repair must be repackaged and shipped subject to the following conditions:

      Do not return any products to factory without first receiving authorization from IFR Customer Service Department.

      CONTACT:

      Customer Service Dept.
      IFR, Inc.
      10200 West York Street
      Wichita, Kansas 67215

      Telephone: (800)-835-2350
      TWX: 910-741-6952

      All test sets must be tagged with:

      (1) Owner's identification and address.
      (2) Nature of service or repair required.
      (3) Model No.
      (4) Serial No.

      Sets must be repackaged in original shipping containers using IFR packing models. If original shipping containers and materials are not available, contact IFR Customer Service Dept. for shipping instructions.

      All freight costs on non-warranty shipments are assumed by customer. (See "Warranty Packet" for freight charge policy on warranty claims.)

   B. Repacking Procedure (Reference - Figure 1):

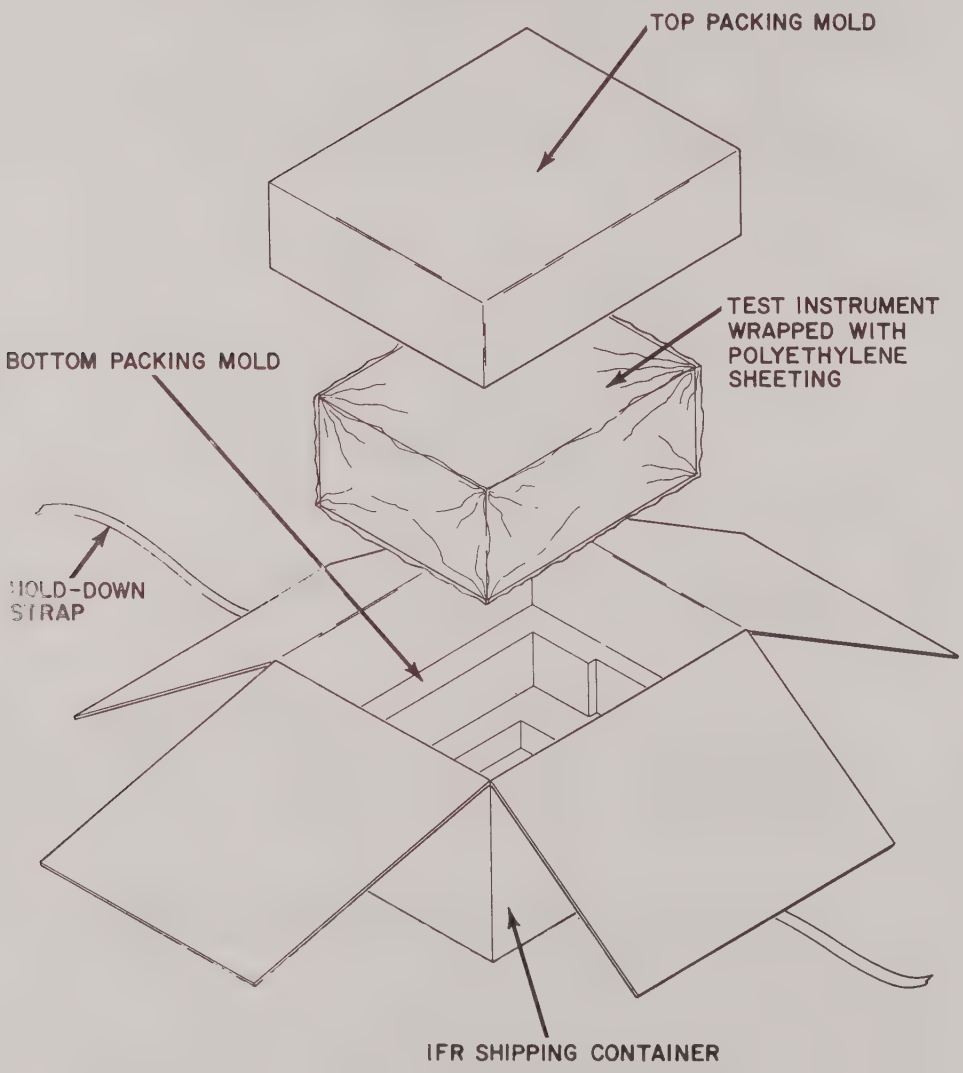
      (1) Make sure bottom packing mold is seated on floor of shipping container.

      (2) Carefully wrap test set with polyethylene sheeting to protect finish.

      (3) Place test set into shipping container, making sure set is securely seated in bottom packing mold.

(4) Place top packing mold over top of set and press down until mold rests solidly on bottom packing mold.

(5) Close shipping container lids and seal with shipping tape or an industrial stapler. Tie all sides of container with break resistant rope, twine or equivalent.



Repacking Procedure
Figure 1

SECTION 5 - STORAGE

1. Please note the following storage precautions:

   A. No particular storage requirements are necessary during extended periods in which the Test Set will not be utilized.

   B. The following common sense practices should be done, however:

      (1) Disconnect the Test Set from any electrical power source.

      (2) Disconnect and store the AC power cable and any other accessories with the Test Set.

      (3) Cover the Test Set to prevent dust and debris covering and entering the Test Set.

APPENDICES

APPENDIX A: R1/R2 AUTO THRESHOLD ADJUSTMENT

1. If there is a need to adjust the R1/R2 AUTO threshold from the factory setting of 0.4 µS, the following procedure applies. (Refer to Figure 1, Section 1 and Figure 1 below.) The Auto point may be adjusted from 0.2 µS to 1.0 µS, as desired (see "Description of Controls, Connectors and Indicators," page 10, Paragraph 1-2-2).

   A. Remove top dust cover of RD-301.

   B. Connect Pulse Generator (50 ohm source impedance) to TEST VIDEO Connector (24) on RD-301 front panel. Adjust output to approximately +3 volt peak.

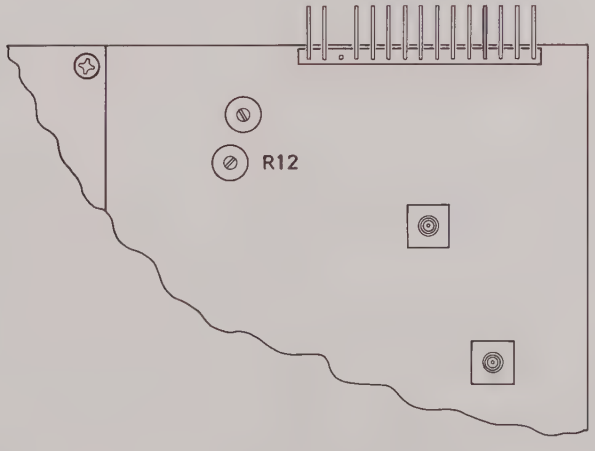
   C. Connect Oscilloscope Channel B to DYLD SYNC Connector (17).

   D. Connect Oscilloscope Channel A to DET Connector (7). Observe either Range 1 or Range 2 reply delay.

   E. Locate Discriminator Board #1 (see Figure 1, Section 1).

   F. Adjust R-12 full cw (see Figure 1 below). Then adjust R-12 ccw until AUTO function changes from Range 1 to Range 2.

   G. Vary Pulse Generator input to TEST VIDEO Connector (21) to verify Auto threshold. Readjust R-12 if necessary.



Threshold Adjustment Point
Figure 1

APPENDIX B: ABBREVIATIONS

1. General

Defined below are various abbreviations and symbols which may be used throughout the text.

2. General Abbreviations

AC	- Alternating Current
AM	- Amplitude Modulation
AMP	- Amplifier
ARINC	- Aeronautical Radio Inc.
ASCII	- American Standard Code for Information Interchange
Assy	- Assembly
ATE	- Automatic Test Equipment
Aux	- Auxiliary
BCD	- Binary Coded Decimal
Bd	- Board
CAL	- Calibration
Cap	- Capacitor
ccw	- counterclockwise
Cm	- Centimeter
Conn	- Connector
Cont	- Control
CPU	- Central Processing Unit
CRT	- Cathode Ray Tube
CW	- Continuous Wave
cw	- clockwise
D/A	- Digital to Analog
dB	- decibel
dBm	- decibels relative to one milliwatt
DC	- Direct Current
DET	- Detector
DLYD	- Delayed
DSCRM	- Discriminator
DVM	- Digital Voltmeter
EXT	- External
Fig	- Figure
FM	- Frequency Modulation
GND	- Ground
GPIB	- General Purpose Interface Bus
Hz	- Hertz
IAW	- In Accordance With
IC	- Integrated Circuit
IEEE	- Institute of Electrical and Electronic Engineers
IF	- Intermediate Frequency
INCL	- Includes
INTF	- Interface
INTL	- Internal
I/O	- Input/Output

APPENDIX B: (Continued)

General Abbreviations

kHz	- kilohertz
kV	- kilovolts
kW	- kilowatt
LED	- Light Emitting Diode
LRU	- Line Repairable Unit
MAX	- Maximum
MDS	- Minimum Discernible Signal
MHz	- Megahertz
MKR	- Marker
min	- minimum
MNL	- Manual
P	- Pin
PC Bd	- Printed Circuit Board
pF	- Picofarad
PNL	- Panel
P-P	- Peak-to-Peak
ppm	- parts per million
pps	- pulse per second
PRF	- Pulse Repetition Frequency
PROM	- Programmable Read Only Memory
PWR	- Power
RAM	- Random Access Memory
Rect	- Rectifier
Ref	- Reference
RF	- Radio Frequency
RNG SEL	- Range Selector
R/T	- Receiver/Transmitter
RTN	- Return
S/A	- Spectrum Analyzer
Sig	- Signal
SN	- Serial Number
STAB	- Stabilization
SW	- Switch
Sync	- Synchronized
T/R	- Transmitter/Receiver
TW	- Thumbwheel
µF	- microfarad
µSec or µS	- microsecond
UUT	- Unit Under Test
V	- Volt
VAC	- Volts Alternating Current
VAR	- Variable
VCO	- Voltage Controlled Oscillator
VDC	- Volts Direct Current

APPENDIX B: (Continued)

General Abbreviations

VHF	- Very High Frequency
VSWR	- Voltage Standing - Wave Ratio
W	- Watt
WX	- Weather
XMIT	- Transmit
XTAL	- Crystal

MP MASTER
MA30544